IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of: **Kenji IMANASHI**

Group Art Unit: **2815**

Serial Number: **09/981,842**

Examiner: **Bradley W. Baumeister**

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PTO Confirmation No.: **7067**

For: **FIELD-EFFECT TRANSISTOR USING A GROUP III-V COMPOUND SEMICONDUCTOR**

Attorney Docket No.: **011287**
Customer No.: 38834

DECLARATION UNDER 37 CFR §1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Sir:

I, Kenji Imanishi, a Japanese citizen, residing in Kawasaki, Japan, do hereby solemnly and sincerely declare that:

I am the inventor of the present patent application, U.S. Patent Application No. 09/981,842.

I am over the age of eighteen and am legally competent to assert this declaration.

I have been involved in the research project of HEMT, High Electron Mobility Transistor, in Fujitsu Laboratory, Ltd. since 1988.

I have calculated the quantum levels in the channel layers of the embodiments of Japanese Laid Open Patent No. 06-236898 (hereinafter JP '898) and the present application. For the calculation, I employed free software, one dimensional

Poisson/Schrodinger Band Diagram Calculator, presented by Greg Snider, Department of Electronical Engineering, University of Notre Dame, Notre Dame, IN 46556, USA.

According to the second embodiment of JP '898, the structure of channel layers is as follows.

Eg = 1.1eV, InGaAsP, 25nm as the second channel layer 3a

Eg = 0.9eV, InGaAsP, 25nm as the first channel layer 3b

The result is shown in Fig. 1. There are four quantum levels in the first channel layer.

According to the fourth embodiment of JP '898, the structure of channel layers is as follows.

Eg = 1.1eV, InGaAsP, 15nm as the second channel layer 3a

Eg = 0.9eV, InGaAsP, 12nm as the first channel layer 3b

Eg = 1.1eV, InGaAsP, 3nm as another channel layer 3c

The result is shown in Fig. 2. There are two quantum levels in the first channel layer.

Further, the embodiment of the present invention is as follows.

InGaAs 7nm as the first channel layer

InAlGaAs (Al = 20%) 20nm as the second channel layer

The result is shown in Fig. 3. Only a first quantum level is in the first channel layer, and the second quantum level is both in the first and second channel layers.

I have reviewed both the JP '898 and JP '934 references. There is no reference that discloses III-V group compound semiconductor including Al as the channel layer for HEMT. When the present invention was made, the inclusion of Al in the channel layer would not be considered by those of ordinary skill in the art due to the poor purity and reactive nature of Al, resulting in crystal defects and/or impurities in the channel layer.

JP '898 and *JP '934* support this point. That is, neither reference discloses a channel layer including Al.

I discovered the combination of InGaAs/In(AlGa)As as the channel layer, in which since the conduction band energy level difference is large enough, even though the first channel layer is thin, it is possible to confine many electrons in the first channel layer. In such a thin first channel layer, the first quantum level can be generated only in the first channel layer and the second quantum level can be generated in both the first and second channel layers. With such quantum levels, more electrons can exist in the second channel layer at the second quantum level. This is not disclosed in any of the references, nor Applicant's admitted prior art.

The undersigned declares that all statements made herein of his/her own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under § 1001 of Title 18 of the United States Code and that willful false statements may jeopardize the validity of the application or any patent issued thereon.

Signed this 8th day of September, 2004

Kenji Imanishi

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